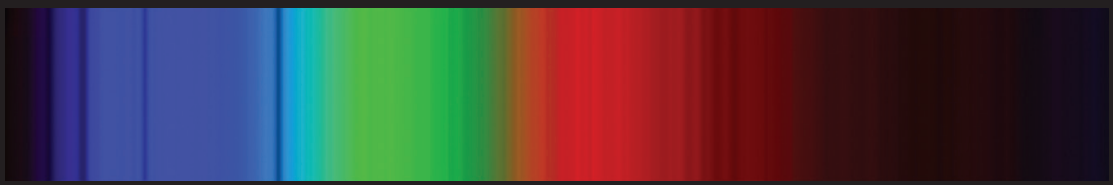
What parts are most visible through the RED, GREEN, and BLUE filters?



This is the spectrum of the star Vega

# Clues to the Cosmos

## Explore the secrets of light and filters

**What do you notice?**

**What is the filter doing?**
What color does the filter let through?

**What are those lines in Vega's spectrum?**
The light we see from a star is white, but when we spread it out, like through a prism, we see a rainbow or spectrum. The star gives off all of the colors, but gas in its outer atmosphere blocks certain wavelengths or lines, giving us clues to the composition of the star!

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STVRYCZKGIPDSJ
VNLVOCDWMXPU
SRGYPNOGCUYTO
RDCUSYUEBNEDK
NTKTEXHMLEVUD
JLRNILPGETHKOT
DYUSEGVMXPWAI

Use filters to decode the secret message.

# Clues to the Cosmos

## Decode a secret message hidden in the light

**Can you break the code?**
Look at the letters through red, green, and blue filters.

**What is happening?**
What colors do the filters let through?

**Your turn!**
Can you make a secret message with the markers and filters?

**Turn your phone into a filter:**
rgb-lens.carnovsky.com

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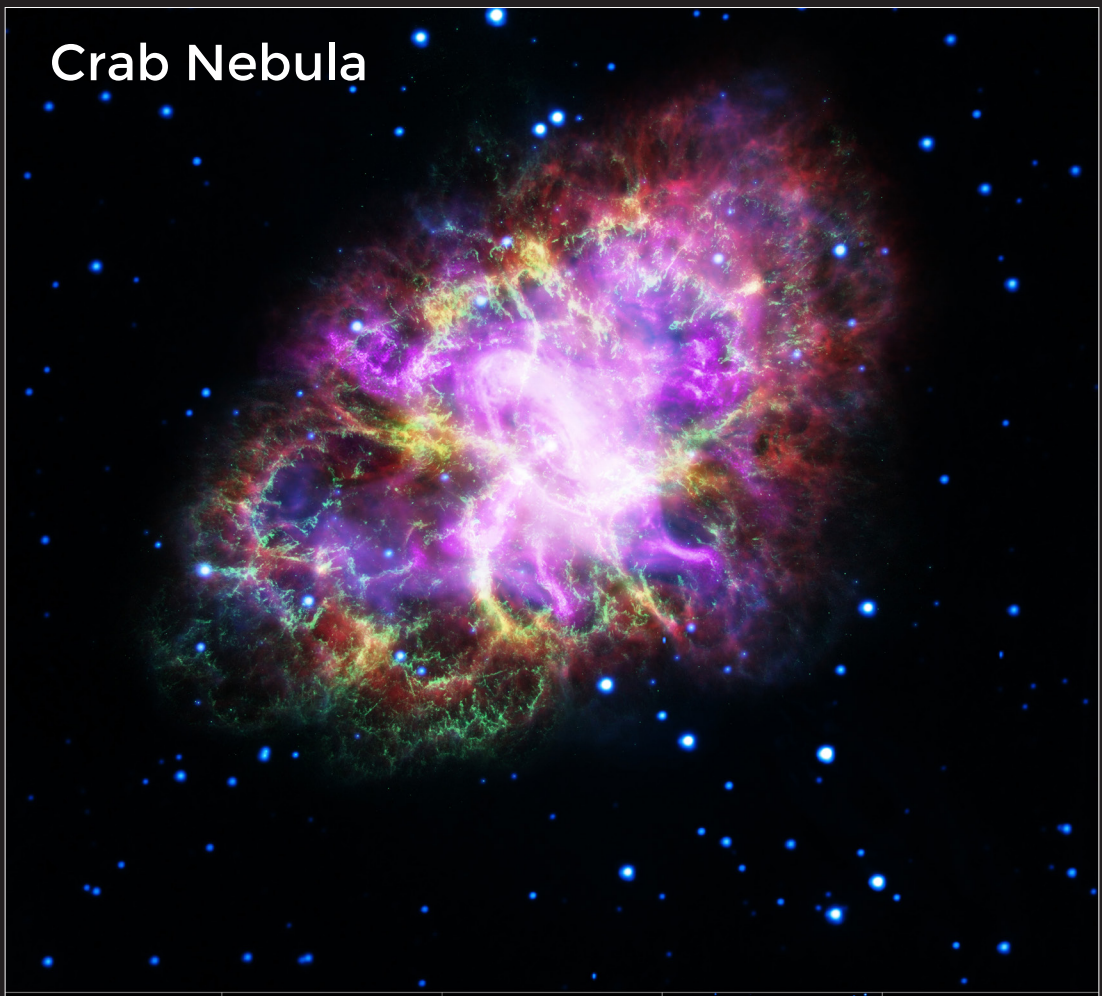
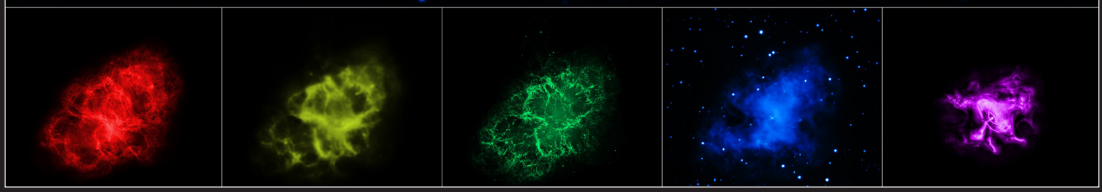
# Crab Nebula





Radio
waves show the fierce wind from the central star.

The Very Large Array

Infrared
light shows the location of dust particles.

Spitzer Space Telescope

Optical
or visible light shows hot filiments radiating out.

Hubble Space Telescope

Ultraviolet and X-ray
light indicate an energetic cloud of electrons driven by the rapidly rotating star - called a pulsar - at the center.

XMM-Newton and Chandra X-ray Observatory

# Clues to the Cosmos

## Astronomers use color to reveal invisible sky secrets

**There is light beyond what our eyes see.**

Astronomers use powerful telescopes on earth and in space to collect light. Some of this light is invisible to our eyes, so they use colors to represent the information in images. This *representational color* tells an important story about an object.

**What would this nebula look like to our eyes?**

**Try this!**
Create your own image:
public.nrao.edu/color

The image is a composite of the Crab Nebula, a supernova remnant.
*Image credit: NASA, ESA, G. Dubner (IAFE, CONICET-University of Buenos Aires) et al.; A. Loll et al.; T. Temim et al.; F. Seward et al.; VLA/NRAO/AUI/NSF; Chandra/CXC; Spitzer/JPL-Caltech; XMM-Newton/ESA; and Hubble/STScI*

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*Detail from Animalia n.2 by Carnovsky*

# Clues to the Cosmos

## Artists use color and filters to see the world in new ways

**How does this image change with filters?**

**Create your own art with highlighters!**
Draw a picture in red, green, and blue and observe the results through filters.

**Make a prediction about your drawing.**
What part of your image do you think you will see through a red filter?

**Take this with you!**
Use your phone as a filter:
rgb-lens.carnovsky.com

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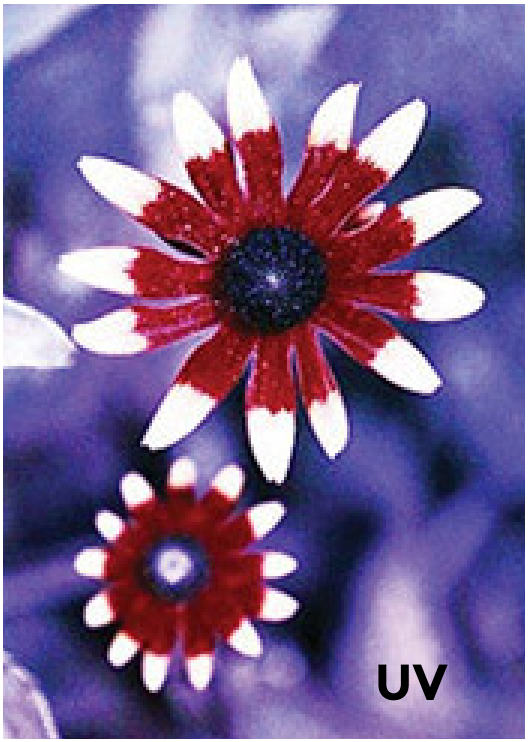
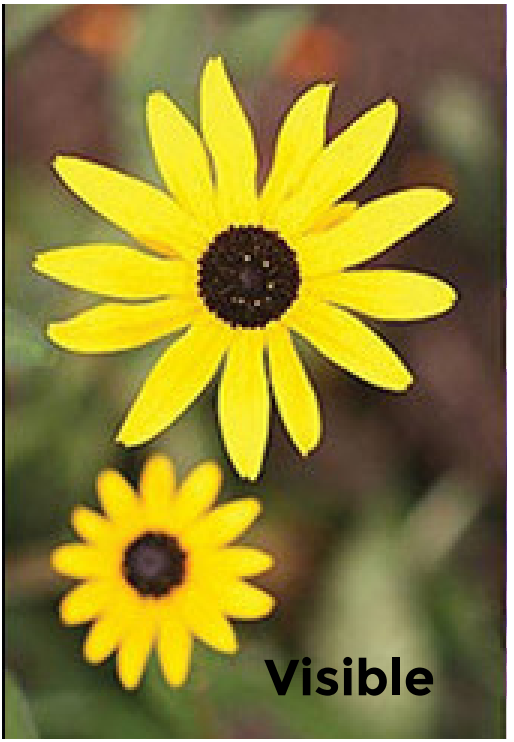
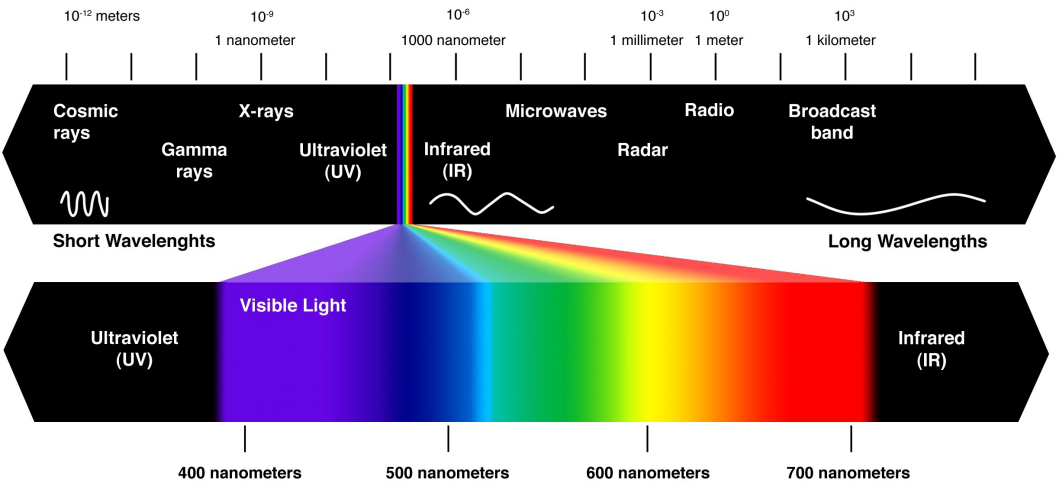
If we could see the flowers as bees see them they would be even more beautiful and varied!

–Richard Feynman




*The Physics Teacher 57, 204 (2019)*



# Clues to the Cosmos

## Some animals see different colors than humans

**What is different about these pictures?**
The left image is what a bee might see in ultraviolet, or UV light. Bees' eyes detect ultraviolet light that our eyes can't see.

**Why do we see different light?**
What information is the bee getting from this flower? Why wouldn't humans see it?

**Shine the UV light on those flowers to see like a bee.**

**Create a secret message with the UV pen!**

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